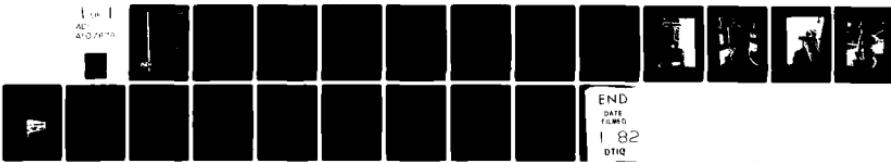


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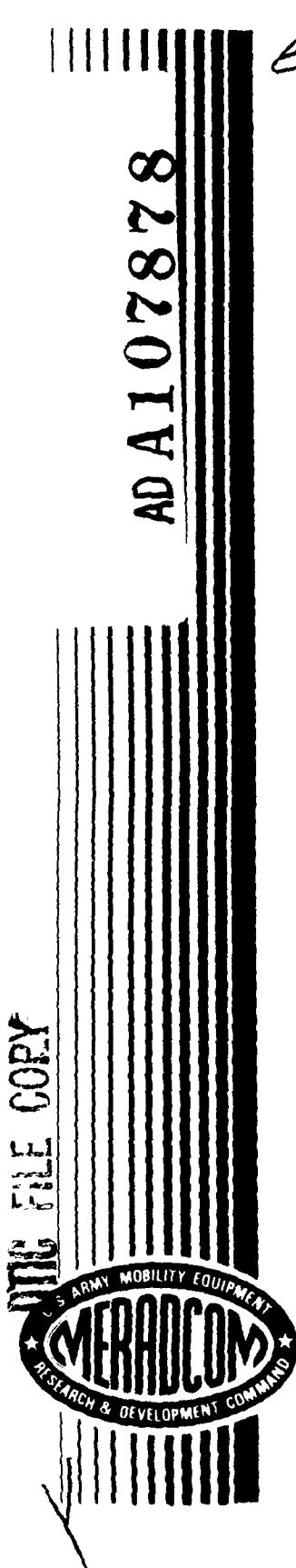
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Report 2334

REMOVAL OF HYDROCARBON TASTE AND ODOR FROM
POTABLE WATER BY REPLACEABLE
CARBON-CONTAINING FILTER CARTRIDGES

by

Elizabeth Radoski

August 1981

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U.S. ARMY MOBILITY EQUIPMENT
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PREFACE

The investigation covered by this report was an evaluation of the Filterite cartridge C40P-W2-U-ECIU, a carbon-containing filter, for the removal of the hydrocarbon taste and odor from potable water contaminated with diesel fuel. Work covered by this report was conducted under Project/Task 1L162733AH20-EW, "Water and Wastewater Management/Investigate Cartridge Filters."

The investigation was conducted by personnel of the Petroleum and Environmental Technology Division, Energy & Water Resources Laboratory, US Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, Virginia. The investigation was directed by Mr. Maurice Pressman, Project Engineer. Mr. Peder B. Pedersen, Engineering Technician, set up the equipment. Mrs. Elizabeth Radoski, Chemist, conducted the tests.

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**THE REMOVAL OF HYDROCARBON TASTE AND ODOR
FROM POTABLE WATER BY REPLACEABLE CARBON
CONTAINING FILTER CARTRIDGES**

I. INTRODUCTION

1. Objective. The objective of this investigation was to determine the effectiveness of the Filterite Cartridge C40P-W2-U-ECIU, a replaceable carbon-containing filter, for the removal of hydrocarbon taste and odor from drinking water made undrinkable by diesel fuel contamination. Tests conducted were part of a test program evaluating POL tanker cleaning and water treatment procedures which would be required to convert POL tankers to potable water service in contingency operations.

2. Background. The investigation covered by this report was conducted as a followup to the study, entitled "Conversion of Army Fuel Tankers to Potable Water Service," conducted during the period July 1979 to August 1979 by Janet Hall, of the Petroleum and Environmental Technology Division, MERADCOM. The objective of the Hall investigation was to evaluate the adequacy of two cleaning methods for converting a 5000-gallon petroleum tanker to potable water service. The Hall investigation was a joint effort conducted by the US Army Quartermaster School, ATSM-CD-M and the Petroleum and Environmental Technology Division, Energy and Water Resources Laboratory, MERADCOM. The investigation was conducted as part of the TRADOC Concept Evaluation Program, No. TRMS9CEP011. Two M857 series tankers were obtained through USATRAADCOM, Warren, Michigan. These two semitrailer tanks, 5000-gal capacity each (an M967, bulk haul model, and an M969, automotive fuel-dispensing model), had contained loads of diesel fuel and leaded mogas. The M967 bulk haul model semitrailer was cleaned with detergent (MIL-D-16791C Type 1) using TB ORD 1031 as guidance and steam cleaned in accordance with par. 52A(3) of TM5-700. The M969 (automotive refueler) model semitrailer was cleaned with a chemical solvent (25 gal of Product-Sol No. 913, an emulsified solvent/detergent mixture). Based on the data obtained during this investigation the following conclusions were drawn:

- a. Both cleaning procedures are acceptable for converting 5000-gal fuel tankers to potable water service.
- b. Even though chemical analysis indicated that the water stored in the tankers met the potable water standards of TB MED 229, the water acquired taste and odor which made it unpalatable.
- c. Water made unpalatable by traces of residual fuel can be made palatable by passing it through granular activated carbon.

The investigation covered in this report was conducted to evaluate the effectiveness of the Filterite cartridge C40P-W2-U-ECIU, a commercially available carbon-containing filter for the removal of the hydrocarbon taste and odor from potable water contaminated with diesel fuel.

II. INVESTIGATION

3. Subject. During tests conducted in June 1979, it was demonstrated that even though POL tankers were vigorously cleaned by detergents or water-soluble petroleum solvents and thoroughly flushed with tap water, potable water stored in the tankers took on an objectionable hydrocarbon taste and odor which made the water unpalatable to a panel of tasters. Laboratory tests indicated that the taste and odor could be removed by passing the water through granular-activated carbon columns. The investigation covered by this report was conducted to assess the possibility of using filter cartridges containing carbon for the removal of taste and odor from fuel-contaminated water. The testing was done by Elizabeth Radoski during the period 25 Nov 80 to 5 Dec 80 at the Petroleum and Environmental Technology Division, Energy and Water Resources Laboratory, MERAD-COM (Figure 1). Samples were collected in styrofoam cups (Figures 1 and 4).

4. Equipment. The following items of test equipment were used:

- a. 500-gal plastic tank (Figure 2).
- b. 30-gal/min electric pump (Figure 3) manufactured by Gould, Inc.; Century Electronic Division; St. Louis, MO 63166.
- c. Filter housing containing eight 40-in. filter tubes (C40P-W2-U-ECIU) marketed by Filterite Corporation; Timonium, Maryland 21093 (Figure 4).

5. Procedure. The 500-gal tank was filled with tap water and contaminated with 1 mg/l of diesel fuel. The contaminated water was pumped through the filter housing equipped with the Filterite cartridges. The filter effluent was sampled at various intervals. The time of sampling, temperature of sample, and taste and odor observations were reported.

III. RESULTS

6. Test Data. The results obtained in the investigation of evaluating the Filterite cartridge C40P-W2-U-ECIU for removal of hydrocarbon taste and odor from potable water contaminated with diesel fuel are given in the Appendix.

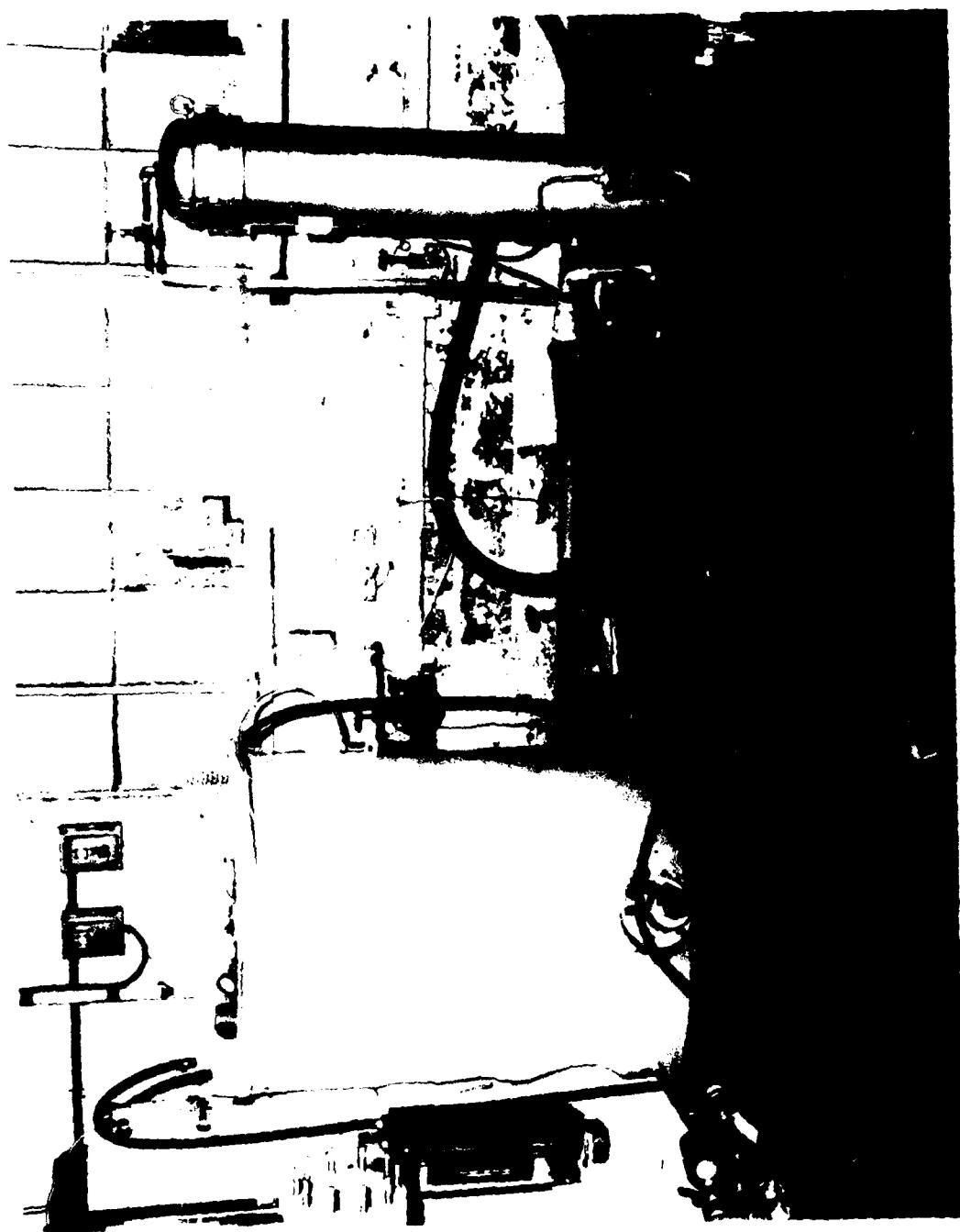


Figure 1. Total system.

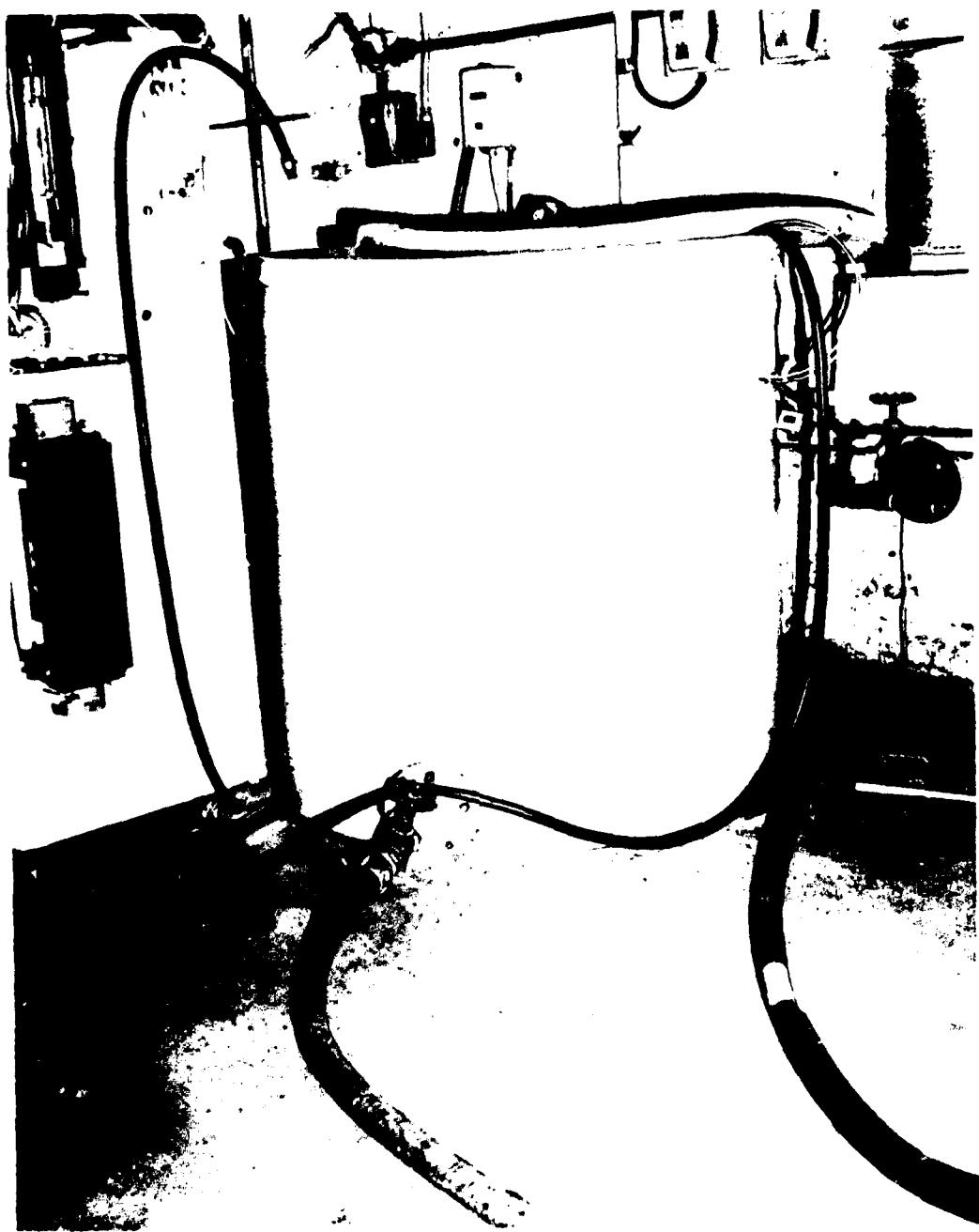


Figure 2. 500-Gal plastic tank.



Figure 3. 30-Gal/min electric pump.

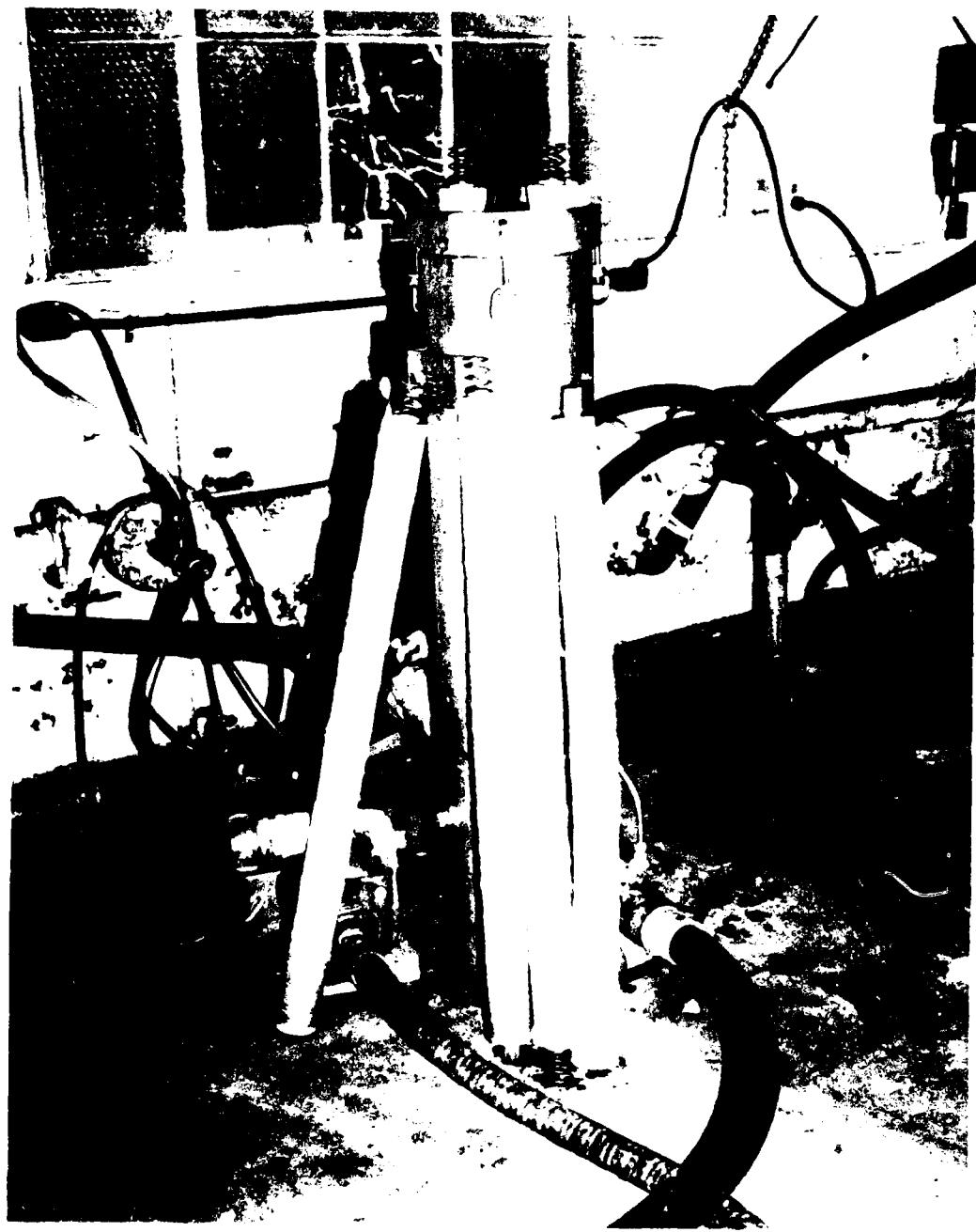


Figure 4. Filterite Corporation open filter housing containing eight 40-in. filter cartridges.

IV. DISCUSSION

7. Discussion. Twenty 500-gal tank volumes of potable water contaminated with 1 mg/l diesel fuel were run through the filter unit. The test water had a strong hydrocarbon taste and odor. The filtered water was free of any objectionable taste or odor. The volume of test water processed through the same filter cartridges is equivalent to two 5000-gal tanker loads of water. The filters were still working effectively after passage of 10,000 gal of water. Breakthrough was not established for the Filterite cartridges because of limitations on the available water for testing due to an area drought condition. Results indicated that the carbon-bearing cartridges were effective for the removal of taste and odor caused by the addition of 1 mg/l of diesel fuel to the potable water.

The Army's 5000-gal POL tanker is equipped with a filter separator (Figure 5) as part of its dispensing system. A detailed examination of the tanker by the Engineering Division of the Energy & Water Resources Laboratory indicated that this filter separator could easily be removed and replaced by a simple housing containing the filter cartridges which were tested. This filter cartridge assembly could serve as an effective polishing filter for the removal of objectionable taste and odor from water dispensed from cleaned POL tankers.

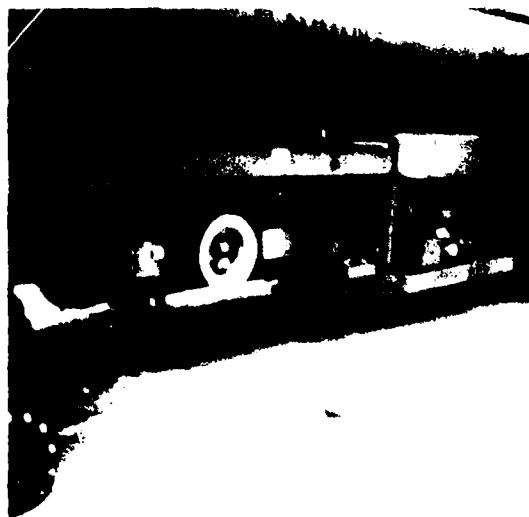


Figure 5. Army 5000-gal POL tanker with filter separation.

V. CONCLUSIONS

8. Conclusions. It is concluded that:

- a. Carbon-bearing filter cartridges effectively removed diesel fuel from potable water contaminated with the addition of 1 mg/l of fuel.
- b. POL tankers can be equipped with a single housing containing carbon-bearing filter cartridges for the conversion of cleaned tankers to potable water transport service.

APPENDIX

DATA OF TESTING RESULTS

Initial observation of contaminated water:

- Oil film visible on surface of water
- Strong diesel fuel odor
- Tasted like gasoline—taste remained on tongue for the day.

| SAMPLE TIME | TEMP | COMMENTS |
|-------------|-------|----------------------------|
| Tank No. 1 | | Date: 25 Nov 80 |
| 5 min | 18° C | Radoski "No odor/No taste" |
| 13 min | 18° C | Radoski "No odor/No taste" |
| 15 min | 18° C | Radoski "No odor/No taste" |
| Tank No. 2 | | Date: 26 Nov 80 |
| 5 min | 18° C | Radoski "No odor/No taste" |
| 13 min | 18° C | Radoski "No odor/No taste" |
| 15 min | 18° C | Hasle "No odor" |
| Tank No. 3 | | Date: 26 Nov 80 |
| 5 min | 16° C | Radoski "No odor/No taste" |
| 10 min | 16° C | Radoski "No odor/No taste" |
| 15 min | 16° C | Radoski "No odor/No taste" |
| Tank No. 4 | | Date 26 Nov 80 |
| 5 min | 14° C | Radoski "No odor/No taste" |
| 10 min | 14° C | Radoski "No odor/No taste" |
| 15 min | 14° C | Radoski "No odor/No taste" |
| Tank No. 5 | | Date: 2 Dec 80 |
| 5 min | 19° C | Radoski "No odor/No taste" |
| 10 min | 19° C | Radoski "No odor/No taste" |
| 15 min | 19° C | Radoski "Potable Water" |
| Tank No. 6 | | Date: 2 Dec 80 |
| 5 min | 14° C | Radoski "No taste/No odor" |
| 10 min | 14° C | Radoski "No taste/No odor" |
| 15 min | 14° C | Radoski "No taste/No odor" |
| Tank No. 7 | | Date: 2 Dec 80 |
| 5 min | 16° C | Radoski "No taste/No odor" |
| 10 min | 16° C | Radoski "No taste/No odor" |
| 15 min | 16° C | Radoski "No taste/No odor" |
| Tank No. 8 | | Date: 2 Dec 80 |
| 5 min | 14° C | Radoski "No taste/No odor" |
| 10 min | 14° C | Radoski "No taste/No odor" |
| 15 min | 14° C | Radoski "No taste/No odor" |

| SAMPLE TIME | TEMP | COMMENTS |
|-------------|-------|-----------------------------|
| Tank No. 9 | | Date: 3 Dec 80 |
| 5 min | 16° C | Radoski "No taste/No odor" |
| 10 min | 16° C | Radoski "No taste/No odor" |
| 15 min | 16° C | Radoski "No taste/No odor" |
| Tank No. 10 | | Date: 3 Dec 80 |
| 5 min | 14° C | Radoski "No taste/No odor" |
| 10 min | 14° C | Radoski "No taste/No odor" |
| 15 min | 14° C | Radoski "No taste/No odor" |
| Tank No. 11 | | Date: 3 Dec 80 |
| 5 min | 16° C | Radoski "No taste/No odor" |
| 10 min | 16° C | Radoski "No taste/No odor" |
| 15 min | 16° C | Radoski "No taste/No odor" |
| Tank No. 12 | | Date: 3 Dec 80 |
| 5 min | 16° C | Radoski "No taste/No odor" |
| 10 min | 16° C | Radoski "No taste/No odor" |
| 15 min | 16° C | Eskelund "No taste/No odor" |
| Tank No. 13 | | Date: 4 Dec 80 |
| 5 min | 14° C | Radoski "No taste/No odor" |
| 10 min | 14° C | Radoski "No taste/No odor" |
| 15 min | 14° C | Radoski "No taste/No odor" |
| Tank No. 14 | | Date: 4 Dec 80 |
| 5 min | 13° C | Radoski "No taste/No odor" |
| 10 min | 13° C | Radoski "No taste/No odor" |
| 15 min | 13° C | Davey "Drinkable" |
| Tank No. 15 | | Date: 4 Dec 80 |
| 5 min | 13° C | Radoski "No taste/No odor" |
| 10 min | 13° C | Radoski "No taste/No odor" |
| 15 min | 13° C | Radoski "No taste/No odor" |
| Tank No. 16 | | Date: 4 Dec 80 |
| 5 min | 14° C | Radoski "No taste/No odor" |
| 10 min | 14° C | Radoski "No taste/No odor" |
| 15 min | 14° C | Radoski "No taste/No odor" |

| SAMPLE TIME | TEMP | COMMENTS |
|-------------|-------|-------------------------------|
| Tank No. 17 | | Date: 5 Dec 80 |
| 5 min | 14° C | Radoski "No taste/No odor" |
| 10 min | 14° C | Radoski "No taste/No odor" |
| 15 min | 14° C | Radoski "No taste/No odor" |
| Tank No. 18 | | Date: 5 Dec 80 |
| 5 min | 13° C | Radoski "No taste/No odor" |
| 10 min | 13° C | Radoski "No taste/No odor" |
| 15 min | 13° C | Radoski "No taste/No odor" |
| Tank No. 19 | | Date: 5 Dec 80 |
| 5 min | 12° C | Radoski "No taste/No odor" |
| 10 min | 12° C | Radoski "No taste/No odor" |
| 15 min | 12° C | Pressman "No taste/No odor" |
| Tank No. 20 | | Date: 5 Dec 80 |
| 5 min | 12° C | Radoski "No taste/No odor" |
| 10 min | 12° C | Radoski "No taste/No odor" |
| 15 min | 12° C | Eskelund "Good Potable Water" |

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